The Phase III Expansion of the White Street Sanitary Landfill

Greensboro, North Carolina

Construction Permit Application

CITY OF GREENSBORO, NORTH CAROLINA

1808

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Monitoring Plan

WHITE STREET SANITARY LANDFILL
GREENSBORO, NORTH CAROLINA

WATER QUALITY MONITORING PLAN

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SECTION 1.0
WATER QUALITY MONITORING PLAN

1.1 Purpose and Intent

The purpose of this plan is to provide a program which describes the collection and evaluation of ground-water monitoring samples collected from compliance wells installed within the uppermost aquifer adjacent to the proposed expansion area and surface water quality samples from the same vicinity. The intent of this plan is to provide detection monitoring throughout the active life and post closure care period at the White Street Sanitary Landfill Subtitle D MSWLF expansion.

This plan was prepared in accordance with the rules codified under North Carolina Solid Waste Management Rules 15A NCAC 13B, Sections .1630 through .1637 under the guidance of a North Carolina Licensed Geologist, and it is certified that this water quality monitoring plan for the White Street Sanitary Landfill Subtitle D MSWLF expansion is effective in providing early detection of any release of hazardous constituents (from any point in this expansion) to the uppermost aquifer, so as to be protective of public health and the environment.

1.2 Description of Plan Components

The following is a brief description of the main components of this water quality monitoring plan.

1.2.1 Water Quality Sampling Locations

The following sections discuss the general rationale used to select the upgradient (background) compliance well and the downgradient (detection) compliance wells based on the geologic and hydrogeologic data obtained during the development of the Hydrogeologic Design Report. All well locations were selected on their basis to provide water quality data from the uppermost aquifer beneath the facility. The rationale for selection of surface water monitoring points is also discussed.

1.2.1.1 Background Well(s)

Using the historical water-table elevation data collected during multiple ground-water monitoring events at the facility, and the geology of the site, two background compliance wells were selected on the basis of hydraulic position in relation to the solid waste management unit. Background well MW-15 is hydraulically "upgradient" of the unit and will be completed in the gneissic material. Background well MW-16 is hydraulically sidegradient of the unit and will be completed in the granitic material. Table 1-1 summarizes the proposed background monitoring wells for this plan and their approximate distance from the edge of the proposed solid waste cell. The location of these proposed wells are shown on Drawing D-6.

1.2.1.2 Downgradient (Detection) Wells

The hydrogeologic and geologic characteristics of the facility and surrounding land, the quantity, quality, and direction of ground-water flow were evaluated to determine the appropriate selection of downgradient (detection) wells. In addition to the criteria above, the distance of each proposed well relative to the waste unit (100 to 150 feet) and the boundary of the property (50 feet or greater) were also considered. Table 1-1 summarizes the proposed downgradient (detection) monitoring wells for this plan and their estimated distance from the subject compliance boundary. The location of these proposed wells is shown on Drawing D-6.

Each downgradient well will be installed with a screened interval of Schedule 40 PVC well screen with a 0.010-inch slotted opening.

TABLE 1-1
SUMMARY OF PROPOSED DETECTION MONITORING SAMPLE LOCATIONS
White Street Sanitary Landfill
Phase III
Greensboro, North Carolina

SAMPLE ID	SAMPLE TYPE	INTERVAL MONITORED	SAMPLE LOCATION AND POSITION		DETECTION MONITORING FUNCTION
			Distance and Direction From Waste Cell Boundary	Hydrogeologic Position	
MW-15	Ground Water	Uppermost Aquifer Gneissic Material	225 Feet Southwest	Upgradient	Provide Background Water Quality Data
MW-16	Ground Water	Uppermost Aquifer Granitic Material	450 Feet Southeast	Sidegradient	Provide Background Water Quality Data
MW-17	Ground Water	Uppermost Aquifer	125 Feet East	Downgradient	Provide Release Detection Data
MW-18	Ground Water	Uppermost Aquifer	135 Feet East	Downgradient	Provide Release Detection Data
MW-19	Ground Water	Uppermost Aquifer	110 Feet Northeast	Downgradient	Provide Release Detection Data
MW-20	Ground Water	Uppermost Aquifer	125 Feet North	Downgradient	Provide Release Detection Data
MW-21	Ground Water	Uppermost Aquifer	125 Feet West	Downgradient	Provide Release Detection Data
MW-22	Ground Water	Uppermost Aquifer	150 Feet North-Northwest	Downgradient	Provide Release Detection Data
MW-23	Ground Water	Uppermost Aquifer	150 Feet West-Northwest	Downgradient	Provide Release Detection Data
MW-24	Ground Water	Uppermost Aquifer	150 Feet West	Downgradient	Provide Release Detection Data
MW-25	Ground Water	Uppermost Aquifer	135 Feet North	Downgradient	Provide Release Detection Data
MW-25D	Ground Water	Deeper Portions of Uppermost Aquifer	125 Feet North	Downgradient	Provide Release Detection Data
SU-1	Surface Water	Tributary/Stream	See Drawing G-1	Upstream	Provide Background Water Quality Data
SU-2	Surface Water	Tributary/Stream	See Drawing G-1	Downstream	Provide Surface Water Quality Data
SU-3	Surface Water	Tributary/Stream	See Drawing G-1	Downstream	Provide Surface Water Quality Data
SU-4	Surface Water	Tributary/Stream	See Drawing G-1	Downstream	Provide Surface Water Quality Data

Shallow wells will have 15-foot screens and deep wells will have 10-foot screens. The construction of the final ground-water monitoring wells will be in general accordance with the North Carolina Well Construction Standards. A schematic showing general well construction details is shown on Construction Permit Application Drawing C-12.

The number and location of the proposed monitoring wells have been selected based on several considerations. First, knowledge of ground-water flow at the proposed expansion area, as described in the accompanying "Design Hydrogeologic Report," indicates that these wells encompass the downgradient area of the expansion. Second, each shallow well will be completed in the uppermost aquifer, with well screens that span the water table. Third, the lateral spacing of these wells was chosen because it is more than adequately close together considering the fine-grained nature of the saprolite aquifer in which dispersion is high. Finally, a well was located downgradient of the leachate collection sump, an area that the State considers particularly vulnerable. Well MW-25 will monitor the northeastern sump, as well as providing monitoring for that general portion of the lined facility.

In addition, a deep well, MW-25D, will be installed as a nest at MW-25. Note also that this well pair is located along the axis of the prominent bedrock surface valley that trends through that area. The actual construction details for the deep well will be worked out in consultation with the State, during installation.

1.2.1.3 Surface Water Sample Locations

Four surface water sample locations have been proposed to monitor the quality of surface water near the solid waste unit. A surface water sample representing background water quality will be collected from the upstream portion of the creek that flows to the east of the disposal area. The downstream surface water samples will be collected from streams that will receive run-off from the landfill area. The location of these proposed surface water sampling locations can be seen on Drawing G-1.

1.2.2 Monitoring Well Data Collection

The following data will be collected and reported during the period of performance for this water quality plan. A brief discussion on the collection of and analysis of these data is provided in the sections to follow.

1.2.2.1 Ground-Water Level Data Measurements

Static ground-water levels (and total well depth) will be obtained from the proposed ground-water compliance monitoring wells immediately prior to purging during each required water quality sampling event. An electronic water level meter capable of measuring differences in water levels of 0.01 feet will be used to obtain these measurements.

All measurements will be obtained from a reference point at the top of each PVC well casing which has an elevation established by a North Carolina registered land surveyor. The horizontal position of each well will be established using North Carolina Plane Coordinates. These data will be used to calculate the volume of standing water in each well and will provide information concerning well integrity (e.g., identify the presence of excessive siltation or casing breaches). All measuring equipment will be decontaminated between use at each well by washing in a non-phosphate detergent solution and rinsing in distilled or deionized water.

1.2.2.2 Ground-Water Direction and Flow Measurements

Water table elevations will be calculated for each monitoring well using surveyed top-of-casing elevations prepared by a North Carolina registered land surveyor. Calculated potentiometric surface elevations, for each sampling event, will be placed on a scaled base map of the facility beside each respective monitoring point and contoured to produce a water table potentiometric surface map depicting potential ground-water flow direction(s) across the expansion area. In addition, estimated ground-water flow velocities for each compliance monitoring point will be calculated for each water quality sampling event. Using the static water table potentiometric data, effective porosities for each well, hydraulic conductivities determined from slug tests of each well, and the calculated hydraulic gradients at each monitoring well for the respective sample event, an estimated seepage (pore water) velocity at each monitoring well will be calculated to evaluate potential contaminant migration.

1.2.3 Sample Parameters and Frequency

1.2.3.1 Analytical Methods

All water quality samples will be analyzed for the constituents listed in Appendix I of 40 CFR Part 258 entitled "Constituents for Detection Monitoring." Table 1-2 lists the Appendix I constituents as well as the preferred analytical method and Practical Quantitation Limit (PQL) for each constituent.

Prior to ground-water quality sampling, each well will be purged of 3 to 5 volumes of standing water or until dry. The volume of water to be removed will be calculated using the measured static water level, well depth, and well diameter of each well. Purge water will be managed in a manner which reduces the likelihood of impact to the surrounding soil.

During the purging process, field measurements (i.e., pH, temperature, and specific conductance) will be collected at each sample location in order to evaluate the effectiveness of purging procedures. These measurements will be obtained from a field-calibrated instrument in accordance with the manufacturers' specifications and industry standards (SW-846). If these field indicators do not appear to have stabilized after 5 well volumes, then well purging efforts will continue until "stabilized" conditions occur.

TABLE 1-2
SUMMARY OF WATER QUALITY ANALYTICAL PARAMETERS

White Street Sanitary Landfill
Greensboro, North Carolina

Metals:

PARAMETER	CERTIFICATION	METHOD	PQL
Antimony	low level	7041	30
Arsenic	low level	7060,7061	10
Barium	(20)	7080,6010	500
Beryllium	low level	7091	2
Cadmium	low level	7131	1
Chromium	low level	7191	10
Cobalt	low level	7201	10
Copper	regular level	7210,6010	200
Lead	low level	7421	10
Nickel	regular level	7520,6010	50
Selenium	low level	7740,7741	20
Silver	low level	7761	10
Thallium	low level	7841	10
Vanadium	low level	7911	40
Zinc	regular level	7950,6010	50

PQL - Practical Quantitation Limit in parts per billion (ppb).

TABLE 1-2 (continuation)
SUMMARY OF WATER QUALITY ANALYTICAL PARAMETERS

White Street Sanitary Landfill
Greensboro, North Carolina

Volatile Organics:

ORGANIC CONSTITUENT	METHOD	PQL
Acetone	8240/8260	100
Acrylonitrile	8240/8260	200
Benzene	8240/8260	5
Bromochloromethane	8240/8260	5
Bromodichloromethane	8240/8260	5
Bromoform	8240/8260	5
Carbon Disulfide	8240/8260	100
Carbon Tetrachloride	8240/8260	10
Chlorobenzene	8240/8260	5
Chloroethane	8240/8260	10
Chloroform	8240/8260	5
Chlorodibromomethane	8240/8260	5
1,2-Dibromo-3-Chloropropane	8240/8260	25
Ethylene Dibromide	8240/8260	5
O-Dichlorobenzene	8240/8260	5
P-Dichlorobenzene	8240/8260	5
T-1,4-Dichloro-2-Butene	8240/8260	100
1,1-Dichloroethane	8240/8260	5
Ethylene Dichloride	8240/8260	5
Vinylidene Chloride	8240/8260	5
Cis-1,2-Dichloroethene	8240/8260	5
T-1,2-Dichloroethene	8240/8260	5
Propylene Dichloride	8240/8260	5
Cis-1,3-Dichloropropene	8240/8260	10

PQL - Practical Quantitation Limit in micrograms per liter (µg /l).

TABLE 1-2 (continuation)
SUMMARY OF WATER QUALITY ANALYTICAL PARAMETERS

White Street Sanitary Landfill
Greensboro, North Carolina

Volatile Organics:

ORGANIC CONSTITUENT	METHOD	PQL
T-1,3-Dichloropropene	8240/8260	10
Ethylbenzene	8240/8260	5
Methyl Butyl Ketone	8240/8260	50
Methyl Bromide	8240/8260	10
Methyl Chloride	8240/8260	10
Methylene Bromide	8240/8260	10
Methylene Chloride	8240/8260	10
MEK; 2-Butanone	8240/8260	100
Methyl Iodide	8240/8260	10
Methyl Isobutyl Ketone	8240/8260	100
Styrene	8240/8260	10
1,1,1,2-Tetrachloroethane	8240/8260	5
1,1,2,2-Tetrachloroethane	8240/8260	5
Tetrachloroethylene	8240/8260	5
Toluene	8240/8260	5
1,1,1-Trichloroethane	8240/8260	5
1,1,2-Trichloroethane	8240/8260	5
Trichloroethylene	8240/8260	5
Trichlorofluoromethane	8240/8260	5
1,2,3-Trichloropropane	8240/8260	15
Vinyl Acetate	8240/8260	50
Vinyl Chloride	8240/8260	10
Xylenes	8240/8260	5

PQL - Practical Quantitation Limit in micrograms per liter (µg /l).

Water quality samples will be collected from the proposed monitoring wells using either a new, disposable fluorocarbon resin (Teflon) or non-dedicated Teflon bailer. If disposable Teflon bailers are used, they will be certified to have been cleaned according to EPA protocol. If non-dedicated sampling equipment is to be used, the portions of the equipment which are placed down or come in contact with any portion of the well will be decontaminated using EPA Region IV decontamination procedures under laboratory conditions

All samples will be transferred directly to the appropriate laboratory-prepared sample containers in a manner which minimizes sample agitation and cross-contamination. The more volatile sample parameters (i.e., volatile organics) will be collected first with the less sensitive parameters (i.e., metals) being the last parameter sampled. A Chain-of-Custody Record will accompany the samples during each sampling event to document changes in the custody of the samples during shipment from the site to the North Carolina certified laboratory.

One trip blank and one equipment blank will be taken during each sampling event to provide QA/QC evaluation of decontamination procedures, sample handling procedures, and container shipping procedures. Trip blanks will be analyzed for volatile organics only, while equipment blanks will be analyzed for volatile organics and metals. A duplicate water quality sample will be collected at least once a year from a selected monitoring well in order to check laboratory accuracy and QA/QC. Duplicate samples will be analyzed for the entire parameter list.

1.2.3.2 Sampling Frequency

Ground-water samples will be obtained during four independent events during the first six months of baseline sampling in order to provide enough data to adequately determine background/natural ground-water conditions or trends. For the remainder of the required monitoring period, water quality samples from all sample points will be collected on a semiannual basis.

1.3 Statistical Evaluation of Monitoring Data

Five methods have been deemed acceptable by the NCDEHNR for the statistical evaluation of ground-water quality data from MSWLF facilities (as referenced in Section .1632 of the Ground-Water Sampling and Analysis Requirements, 15A NCAC 13B). Each of these tests have inherent advantages and disadvantages which render them more or less useful, depending on site and data set characteristics. Each method is briefly described below. In addition to the statistical analysis of the data, all sampling analytical data will be compared to the North Carolina Ground-Water Standards, 15A NCAC 2L, .0202.

1.3.1 ANOVA (Parametric)

A parametric analysis of variance (ANOVA) followed by multiple comparison procedures to identify specific sources of difference is the preferred method for a facility in the early stages of monitoring. The procedures include estimation and testing of the contrasts between the mean concentrations at each compliance well and those at the background well for each constituent.

Analysis-of-variance models are used to analyze the effects of an independent variable on a dependent variable. For ground-water monitoring data, a well or group of wells is the independent variable, and the aqueous concentration of certain constituents or of a specified contaminant or contaminants is the dependent variable. An analysis-of-variance can determine whether observed variations (differences) in aqueous concentrations between compliance and background wells are statistically significant. Use of analysis-of-variance models is appropriate in situations where background concentrations of specific constituents can be determined and the data are normally or log normally distributed. The constituents which are most appropriately evaluated using ANOVA approaches are naturally occurring metals and other geochemical parameters such as chloride, nitrate-N, and specific conductivity.

1.3.2 ANOVA (Non-Parametric)

A non-parametric analysis of variance (ANOVA) based on ranks followed by multiple comparison procedures to identify specific sources of difference can be used when the data are not normally distributed and cannot be transformed into a log-normal distribution. The procedure includes estimation and testing of the contrasts between the median of each compliance well and the background well for each constituent. This is a non-parametric procedure, which means that the laboratory values are not used; only the relative ranks are used.

1.3.3 Tolerance/Prediction Intervals

A tolerance interval or a prediction interval for each constituent is established from the background data. The concentration of each constituent in each compliance well is compared to set upper (or lower) tolerance or prediction limits.

Tolerance intervals define, with a specified probability, a range of values that are expected to contain a discrete percentage of the sample population (95%). Tolerance intervals are most appropriate for facilities which do not have high degrees of spatial variability between background and compliance well (e.g., areas underlain by homogeneous geologic materials such as granitic saprolite). With ground-water monitoring data, tolerance intervals can be constructed from concentrations found in the background well(s); these intervals are most often expressed as limits defined by the mean background well concentration plus a population size determined multiple of the standard deviation of the mean. Possible ground-water contamination is indicated when concentrations of the specified constituent(s) at the compliance well(s) plot above the calculated tolerance interval limits.

Prediction intervals are intervals in which the user is confident at a specified percentage (95%) that the next observation will lie within the interval, and are based on the number of previous observations, the number of new measurements to be made, and the level of confidence that the user wishes to obtain. This method of statistical analysis can be used in both detection and compliance monitoring programs. The mean concentration and standard deviation are estimated from the background wells. In a compliance monitoring program, prediction intervals are constructed from compliance well concentrations beginning at the time the facility entered the compliance monitoring program. Each compliance well observation is tested to determine if it lies within the prediction interval. If it is greater (or lower) than the historical prediction limits, water quality has deteriorated to such a point that further action may be warranted.

1.3.4 Control Charts

A control chart approach provides control limits for each constituent which can be used to evaluate data produced by repeated sampling and analysis for each well in the monitoring network. This is an intrawell approach which does not involve a comparison between background and compliance wells. If any compliance well has a value or a sequence of values that lie outside of the control limits for that constituent, this may constitute statistically significant evidence of contamination.

Control charts are based on repeated independent sampling events conducted over time and may be developed for each constituent of interest. Different statistical measurements, such as the means, standard deviation and mean of replicate values at a point in time, are computed and plotted graphically together with upper predetermined limits on a chart in which the x-axis represents time. When a data point plots above these boundaries, the process is "out of control," and when it plots below the boundaries the process is "in control." Control charts can be used to analyze the inherent statistical variation of ground-water monitoring data, to note aberrations and to detect trends in the data. Further investigation of "out of control" points is necessary before taking any direct action. A control chart can be constructed for each constituent in each well to monitor the concentration of that constituent over time. New samples can be compared to the historical data from the well to determine if the well is "in or out of control." Control charts can also be used to evaluate ground-water monitoring data when these data have been adjusted and/or transformed as appropriate.

1.3.5 Other Statistical Methods

Other statistical methods submitted by the facility owner or operator and approved by the NCDEHNR may also be used. This could include development of confidence intervals in which data are compared to Federal or State established maximum contaminant limits (MCLs) or alternate contaminant limits (ACLs).

1.4 Detection Monitoring Reporting

The reporting of detection monitoring data will occur within 14 days from the completion of the statistical analysis of the ground-water quality analytical data. A report will be prepared which summarizes the sampling event; including field observations relating to the condition of the monitoring wells, field data, laboratory data, statistical analysis, sampling methodologies, quality assurance and quality control data, information on ground-water flow direction, and calculations of ground-water flow rate.